REMARKS

Applicant has carefully reviewed and considered the office action and the references relied upon by the Examiner. Entry of the above amendments is respectfully requested. Claims 1 and 13 have been amended without adding new matter.

CLAIM REJECTIONS-35 U.S.C. §102 AND 103

Claim rejections-35 U.S.C. 102

Claims 1 and 7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Wang et al. (US 6,387,806, dated 5/14/02).

Amended claim 1 in the present invention teaches a method of forming a copper wiring in a semiconductor device, comprising: forming a copper wiring in the damascene pattern by means of a chemical mechanical polishing process, wherein the chemical mechanical polishing process is performed until a top surface of the copper wiring is concave from a top view and the top surface of the copper wiring has a lowermost portion disposed below a top surface on the interlayer insulating film; performing an *annealing process to convert the concave top surface of the copper wiring to a convex top surface* so that side edges of the copper wiring that engage the copper anti-diffusion conductive film are disposed below a top surface of the interlayer insulating film; and forming *a copper anti-diffusion insulating film on the entire structure* including the top surface of the copper wiring having the convex shape, thereby flatting a surface of the entire structure.

However, Wang does not teach or even suggest that performing an annealing process to convert the concave top surface of the copper wiring to a convex top surface and a copper anti-diffusion insulating film on the entire structure.

Referring to Wang, thermal anneal is performed after CMP. However, the shape of the top surface of the copper wiring is not converted. In contrast, the shape of the top surface of the copper wiring is converted in the present application. That is, a concave top surface of the copper wiring is converted to a convex top surface of the copper wiring.

Also, in Wang, the encapsulating material 222/224 is formed only on the top surface of copper 218/230. However, in the present application, the copper anti-diffusion

insulating film 200 is formed on the entire structure including the top surface of the copper wiring in the present application. Thus, the present application can prohibit electro-migration and stress migration of copper. It is thus possible to improve reliability of the wiring.

Accordingly, amended claim 1 in the present invention is clearly patentably different from what is disclosed in Wang. Therefore, claim 7 depending on the base claim 1 is also in condition for allowance.

Claims 13, 15, 19, 21, 23 and 25 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Saito et al. (US 2003/0109129).

Amended claim 1 in the present invention teaches a method of forming a copper wiring in a semiconductor device, comprising: forming a copper wiring by means of a chemical mechanical polishing process, wherein the chemical mechanical polishing process is performed until a top surface of the copper wiring is concave from a top view and *the top surface of the copper wiring has a lowermost portion disposed below a top surface of the interlayer insulating film; performing an annealing process to convert the concave top surface of the copper wiring to a convex top surface* so that side edges of the copper wiring that engage the copper anti-diffusion conductive film are disposed below a top surface of the interlayer insulating film; and forming a selective copper anti-diffusion conductive film on the top surface of the copper wiring having the convex shape.

Referring to Saito, the top surface of the copper M1c is not lower than the top surface of the insulating layer 22b.

Also, the top surface of the copper M1c is not converted. The top surface of the copper M1c is maintained in concave shape.

Accordingly, amended claim 13 in the present application is clearly patentably different from what is disclosed in Saito. Therefore, claims 15, 19, 21, 23 and 25 depending on the base claim 13 are also in condition for allowance.

Claim rejections-35 U.S.C. 103

Claims 16-18, 20, 22 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saito et al. (U.S. 2003/0109129).

Claims 3-6 and 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al. (U.S. 6,387,806) in view of Noguchi (US 2003/0114000).

As traversed under claim rejection 35 U.S.C. 102 above, Applicant believes that claims 3-6, 8-12 16-18, 20, 22 and 24 depending on the base claims are condition for allowance since the base claims are patentable over the cited references.

CONCLUSION

In view of the above remarks, Applicant believes that the amended claims 1 and 13 are patentable over the cited references and claims 3-12 and 15-25 depending on the base claims are also in condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 13-2855, under Order No. 29936/39889 from which the undersigned is authorized to draw.

Dated: July 5, 2006

Respectfully submitted,

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